Undertaking research at the interface between disciplines

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Undertaking research at the interface between disciplines: questions of purpose, method, and possibilities

Dr. Laura Colucci-Gray, University of Aberdeen, School of Education

ABSTRACT

In the context of the social and environmental challenges confronting the Earth in the age of the Anthropocene, a need emerges for a reconfiguration of current models of knowledge production to enable more sustainable approaches and actions. Examining different epistemological positions, this paper invites future researchers coming from different disciplines to explore and grapple with the opportunities embedded in dialogue. An argument is put forward for education – represented by teaching and research in our universities – to embed knowledge and learning within an ecological view. The ongoing interrogation of ourselves in relation to others, both living and non-living, brings recognition of our interdependence, and the embodied, affective nature of our being-with others.

Keywords: Sustainability science; dialogue; participation; interdisciplinary; education

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Introduction

In 2016, the International Union of Geological Sciences (IUGS), the professional organization in charge of defining the Earth's geological timescale, officially referred to a new epoch - the Anthropocene – or the age of man - as the current period of human history. In the words of one of the leading scientists who put forward the term, William Steffen indicated:

> "[it] *will be another strong reminder to the general public that we are now having undeniable impacts on the environment at the scale of the planet as a whole'* (cited in Stromberg, 2013).

Since its inception, the word has gained momentum in the scientific community; a new academic journal bearing the title 'Anthropocene' was launched in 2017 by Elsevier, while related publications mentioning the Anthropocene are gaining thousands of citations. From a linguistic point of view, it is worth observing how such term is both logically and rhetorically powerful. On the one hand, the 'age of man' centralises human activities. Images of archaeological relics and remains are a testimony of the passage of a species, the human, which has reached out into the deepest regions of the Earth. Taking centre stage, the human species is logically positioned for taking charge of the Planet, deploying creativity and innovation to respond to current challenges (see Westley et al., 2011). On the other hand, human actions are not located in the distant past; they are in effect the manifestation of current, timely events unfolding through ongoing cultural and technological innovation as well as widening of unequal power relationships amongst human communities, and between humans and non-humans. Rhetorically, the 'age of man' shows the ambiguity and paradoxes of celebrity: glory loaded with responsibility.

In this scenario, the need to agree as to whether human impacts can be quantified and described as 'epochal markers', raises some interesting ontological and ethical questions, which trace back to a long-standing debate on the relationship between human beings and the rest of the cosmos. I will argue that such questions extend beyond the sciences to encompass wider educational and formative processes, to which the University as a place of both Research and Education is invited to respond.

Powerful knowledge and troubled relationships

As Hannah Arendt envisaged already half a century ago, "for the first time in history all peoples on earth have a common present", even if "this common present is not based on a common past, and does not in the least guarantee a common future" (1968, p. 83). More than coincidentally, this awareness of the human condition in contemporary societies brings to the fore the necessity to interrogate current systems of knowledge and techno-scientific developments; their positioning in relation to current divisions between 'haves' and 'have-nots'; between those who pay for consequences and those who describe them. The imperatives of the new epoch are ecological, political, and fundamentally, human. While scientists are seeking to rise to the challenge of a global Earth science, which may provide the knowledge and empirical data to quantify and measure risks and possibilities in the Anthropocene, equally valid questions pertain to the nature of such knowledge, how it is derived, and by whom.

The epoch of the European Enlightenment in the early 1800 offers a useful starting point for this inquiry. At a time of vast industrial expansion, the need for measurement and standardisation grew alongside a body of knowledge aptly defined by specific 'realms of expertise', that is, areas of disciplinary knowledge demarcated by a narrow focus, specialist language and a set of methodological criteria used to justify the validity of claims. Disciplinary divisions have enabled the growth of knowledge across a number of areas; however, this model of knowledge production appears largely unconcerned with higher order questions, such as the worth of what is known beyond the needs and requirements of those who produced it, and/or commissioned it, or the impacts on those who sit outside the circle of expertise.

Challenges to traditional, disciplinary knowledge have become increasingly more evident in the face of global environmental crises, which have exposed the limitations of singular approaches, and surfaced the need to adopt new philosophical outlooks on the validation of claims:

> "*this is not to say that reductionist science cannot help scientists understand ecological systems. I am simply arguing that reductionist science alone will not suffice*" (Maurer, 1999, p7).

Extending the critique further, Sole' and Goodwin (2000) pointed to the holistic nature of Earth systems:

> "*progress in understanding natural phenomena requires more than a study of parts in interaction. It often involves grasping relevant aspects of whole systems*" (p.19).

Critiques of disciplinary 'knowledge' systems point to the emergence of a variety of epistemological frameworks; each one differing for the degree to which researchers are taking cognisance of their role in the definition of the problem, the choice of variables, focus and methods. A 'dappled view' of scientific knowledge - as in the account given by Cartwright (1999) – begins to emerge. The world is no longer the place of order and regularity. Rather, it is a more diverse, dangerous, and possibly a more interesting place, calling for an equally diverse and courageous stance on knowledge, one which may refuse consensus and/or centralisation, and one which may require further consideration.

Changing relationship between science and society and emerging modes of knowledge production

The wide array of contributions coming from the field of Science and Technology Studies is indicative of the current pace of change. While referring to science and technology generally as domains of knowledge, it is important to recognise a significant shift which has occurred since the fifties with the rise of 'Big science' projects, largely funded by Governments to support the industrial infrastructures for economic growth in post-war era. Nylon industries, packaging, and aviation industries are some examples, but we also include the use of 'scientific' methods for food production. The 'green revolution' followed by the 'blue revolution' exemplify the 'great acceleration', shifting from an economy dependent on the sun and manual labour to an oil-economy, powered by the machine for intensive production. Such changes in the ways science and technology operate vis a' vis society and the environment have been encapsulated by new models of knowledge production. Nowothny, Scott and Gibbons (2001) distinguished between Mode 1 to Mode 2 to describe the rise of the Government as a 'stakeholder' in the global economy, and increasingly, the private sectors, as both commissioners and sponsors of research to serve economic and societal needs. More recently, Mode 3 (Nowothny, 2005; Benessia et al., 2012) is emerging as a model of knowledge production in hybrid spaces, across policy, academia, industry, and the civil society. In this third model, great emphasis is placed on public engagement with research and the evidence of 'impact', to justify the social usefulness of research and its returns on investments.

From science to techno-science

If such theorisations are pointing to an extension of the collective in matters pertaining to knowledge and its relevance to society, a critical analysis also considers a set of more profound and tangible changes. Research deemed to be useful and impactful arises from the powerful marriage between science and technology in what is known as 'technoscience' (for fuller discussion see Colucci-Gray, and Camino, 2016), an enterprise of transformation of natural systems and social relationships at a global scale. Following Latour's observation (Latour, 2005), the Planet has become a global laboratory. Techno-science opens natural boundaries and operates directly onto the web of social, ecological, and evolutionary relationships. The question of involvement of the collective is thus a normative and cultural problem: are we are able to regulate appropriately, across time, places and different historical contexts?[1]

Grappling with matters of regulation, risk and safety however, challenges singularity and brings into account the multiplicity of experiences. Arendt (1994) referred to this point as a question of "style" which is "bound up with the problem of understanding" (p.404). According to Arendt, the way in which we think and seek to understand the world is intertwined with the ways in which we allow our different *experiences* to surface. Hence, there are important considerations to be made about the process through which such experiences may become visible and transparent to others. The question of 'regulatory frameworks' will thus call for a

[1] We note here the example of differing regulations regarding GMO products namely by the European Union and the Federal Drugs Administration (see Benessia, Barbiero and Guarnieri (2014) for an analysis of the GM Salmon; similarly, digital technologies are generating child protection issues which are subjected to different policies across different Sates.

deeper interrogation of the methods and processes for acting in the hybrid spaces of knowledge production opening up in the Anthropocene.

Sustainability science as a newly emerging epistemological landscape

Seeking to capture such phenomenal changes across nature and culture, science and politics, rich contributions are offered by the relatively recent field of sustainability science. In the definition provided by Kates (2011), sustainability science is a different kind of science that is primarily use-inspired, as are agricultural and health sciences; with significant fundamental and applied knowledge components, and a commitment to moving such knowledge into societal action. From an epistemological perspective, this science of sustainability is seeking to integrate a wider set of disciplines, knowledge systems, questions, and methods with an openness towards interdisciplinary dialogue. In spite of these aspirations however, an open debate still exists on the status of those who contribute to knowledge production, the nature of their mutual relationships and even the modalities and purposes for extending the involvement and participation of people and communities outside the academic world.

For example, in a study conducted by Kates, (2011), of 232 research papers in the sustainability section of the Proceedings of the National Academy of Sciences (PNAS), 62% had a major focus on sustaining environmental life support systems, as contrasted with 38%that primarily addressed human well-being, and only a few that addressed poverty alleviation. Such results are indicative of the ways in which different teams of researchers frame the focus and mission of their inquiry, in different localities; and by responding to significantly different policy and cultural frameworks (Munafo', 2017). Consequently, it is not only the nature of the topics which are being affected, but notably, it is the nature of the questions and choices of methodological frameworks, which are shaped by the type of interdisciplinary assemblages (natural sciences and human sciences), the prominence of particular disciplines (with preferred variables; languages; modes of inquiry), audiences and even publication outlets. Such considerations open the way to other approaches to knowledge production as they are currently emerging across the wider cross-disciplinary 'ontological turn' (e.g. Ingold, 2010), which emphasises non-representational views of knowledge and the impossibility to separate knowledge from context, subjects, and the ways in which they have come into relation. Hence, understanding how knowledge production across disciplines works is key to the quality of sustainability science and central to an understanding of this field of inquiry and practice.

The contested landscape of sustainability science

In an extensive review, Ziegler & Ott (2011 identified a set of four key features underpinning interdisciplinary dialogue in sustainability science, and namely: 1. normativity; 2. urgency; 3. inclusion of non-scientists and 4. interrelations of environment and society. Perhaps unsurprisingly, each dimension is filled with contestation. For example, normativity requires an agreement around the definition of sustainability as the underpinning concept. Notably, whether sustainability should be defined as *weak* or *strong* is not a universal decision, as it impinges upon differential theories of justice and arguably, very different ideas of nature and the relationship between humans and the natural systems. A lively and feisty philosophical debate surrounds the problem of defining nature a priori (Armitage, 2003; Bonnett, 2003; Lamb, 1996). Equally complex epistemological questions are posed by the concept of 'interrelation' between environment and society, a position which presumes an original

distinction or a gap between humans and non-humans, which 'interrelation' seeks to overcome. Arguably, the idea of a separation between humans and the natural world (Ives et al., 2017), is a typical Western construct, an outdated construct, holding onto Enlightenment ideas and which does not take account of other cultures and traditions (Descola, 2013).
Adding to such complexity, the question of urgency and the inclusion of non-scientists both imply an ethical supposition; the fact that we live in a world where the basic needs of a majority of human populations are not met, almost naturally points to the necessity to tackle problems quickly and at a large scale. Yet, time is not unequivocally or universally experienced and defined, but it is a constitutive part of the realities of different groups and individuals. The rather short-scale of research and situational time for example, will differ from the extended biographical and historical time (Thomson and Holland, 2003), all of which will place a different emphasis on urgency and the decisions pertaining to when problems may need to be addressed and by whom[2].

We can see how the richness of such debates accounts for the growth and extremely variegated nature of sustainability science. Along with Propper (2018), it is worth observing the range of contributions stemming from techno-political solution-seeking processes (e.g. climate governance, ecosystem services management, reducing emissions from deforestation and forest degradation) to participatory processes, seeking to engage people' s imaginations, lifestyles and behaviours. In one case, the aim is largely that of providing knowledge for the scientific community and the public, informing societal or policy decision-making through numerical representations of scientific results. Conversely, top-down, evidence-informed policy-making processes, which seem to hanker to the idea of science as a puzzle-making and problem-solving exercise, are critiqued on ontological grounds for adopting a view of reality as a 'given' and 'out there', while ignoring the influence of policy-framing on the definition of problems and expected results (Sarewitz, 2004).

Post-normal science and the 'dilemma of inclusion'

Recognising the complex interrelation of facts and values, knowledge and culture, another strand of epistemological debate is stemming from the now relatively established domain of post-normal science (Funtowicz, 2002). This framework recognises that in conditions of complexity, when stakes are high, and values are in conflict, there is a need to involve the extended peer-community. By putting emphasis on the requirement to match policy frameworks with lived practices, post-normal science openly challenges the traditional separation between the domains of 'words' and 'experiences'. A key dimension of this mode of knowledge production is no longer the burden of evidence but the 'dilemma of inclusion' (Ravet, 2011), which is characterised by the existence of contrasting perspectives on the opportunities to participate that are given or made available to particular groups. Such debates influence the way in which questions are being asked at different times in the process. For example, in some instances, emphasis may be placed on 'democratising expertise'; hence, a technocratic focus may emerge as a means to gain access to, giving and/or

[2] Illustrative examples in this regard are provided by the report "Late lessons from early warning" published in 2013 by the European Environmental Agency. A range of case studies dealing with chemical and technological innovations highlight the systemic nature of environmental issues. In particular, the differential application of the precautionary principles was significantly affected by the extent to which people engaged with the memory of the community, time-span for decision-making and whose expectations/demands were being met.

receiving information[3]. In other instances, the focus may be more strongly located on '*expertising democracy'* (Liberatore and Funtowicz, 2003). The latter brings with it important educational elements, such as the ability to interrogate and creatively transform the values encoded in the physical, normative, and relational spaces of people's participation to fulfil new needs and to develop new abilities. Choosing one approach over the other however may not be possible or even desirable given the fluidity and indeed, the apparent situational complexity (Ravet, 2011) of current issues. What may be possible to suggest is that such debates are in fact crucial to the process of knowledge production, affecting what knowledge processes might be possible when operating across disciplinary boundaries, the differential sets of expertise involved and the outcomes. However, engaging with such debates may call for greater disposition and ability towards dialogue across boundaries. Dialogue is a multi-layered construct, encompassing the ways in which research departments are organised through to the experiences of future teachers and researchers who are trained in universities to come together, explore and compare their respective contributions. In the following sections, I will aim to outline what might be the features of such a wider educational process seeking to encourage more sustainable approaches.

Many layers of interdisciplinary dialogue

A fundamental premise of both sustainability science and post-normal science approaches lies in 'collaboration' and 'dialogue' amongst people holding different perspectives and points of view. Perspectives may be disciplinary but also experiential, linguistic, and cultural. In discussing dialogue amongst different disciplines, Max-Neef (2005) distinguishes between pragmatic/purposive disciplines (i.e. medicine, agriculture, and engineering), normative disciplines (politics, law; economics) and value-based disciplines (ethics; philosophy). Multi, inter and trans-disciplinarity are thus defined on the basis of the questions which are being asked by each project, and the nature of the integration across the different levels of inquiry. So, according to Max-Neef (2005), multi and pluri-disciplinarity occurs when disciplines contribute knowledge at the same hierarchical level and thus are able to assemble information to respond to a common question or objective. Conversely, inter-disciplinarity and trans-disciplinarity connotes coordination of a lower level from a higher one, potentially challenging original ways of thinking in the specific disciplines to take account of a wider focus or alternative value-frameworks. In interdisciplinarity: *"… a sense of purpose (empirical, normative, ethical) is introduced*", through coordination of two hierarchical levels. For example, medicine becomes interdisciplinary when granting a defined purpose to the empirical field represented by biology, chemistry, and psychology. In trans-disciplinarity, coordination and integration can occur at all hierarchical levels and involve several groups of disciplines. At the basic level, questions are factual and descriptive: *what exists?;* At a second level, the concern may be methodological*: "what are we capable of doing"?; "how does our focus affect what we are able to know?".* And finally, at the higher levels the question becomes ethical and normative*: what is it that we want to do and why? What are the underlying motivations and how are such motivations identified as being important?*

[3] For example, debates on the aims and practices of citizen science centre upon this problem. Authors may differ in relation to their concern with extending the boundaries of knowledge and expertise (Collins and Evans, 2002). Conversely, others wish to focus on challenging the linguistic and practical decisions at the basis of agenda setting and problem-posing to counter the hegemony of Western science and favour cultural change (McQuillan, 2014).

The analysis of disciplinary integration offered by Max-Neef (2005) captures the creative nature of Science &Technology governance vis a' vis Innovation. The imperative to tackle global problems can be seen to adhere to a number of beliefs that are in part descriptive, in part normative, in part explicit, in part implicit. To exemplify such considerations, Camino and Colucci (2016) offered an analysis of a scientific study advancing the case for nuclear power as the safest option to tackle climate change. The authors of the research under consideration claimed to have been able to "demonstrate" the potential for a "large-scale expansion of global nuclear power", by drawing on empirical data collected over three decades in France and Sweden. This example was selected for the apparent entanglement of the different levels involved in trans-disciplinary inquiry, spanning the natural, physical, and social sciences. So, if nuclear power may be a practical solution responding to the normative demand of climate change adaptation in a Western context; advocating large-scale expansion to countries with high levels of rural poverty or the presence of militarised regimes can only be justified on the presumption that nuclear energy leads to economic growth; that the benefits can be reaped by all through economic prosperity (at some level) and the creation of jobs, and this is a good in itself. Potential dangers to humans and the planet, are justified and possibly overridden via a hidden justification of material satisfaction, value for money and productivity. Strand et al. (2016) refer to such inferences as *discursive moves* based on and reinforced by cultural narratives which are encoded in the biography, gender, context, and apparatus of scientific research. Notably, the harmful collaterals of technological change, the uncertainties, and the lack of evidence - for example in relation to disposal of waste or considerations about safety for people in case of accidents – are dealt with by risk assessment and management, technological refinement, and remediating technologies (Strand et al., 2016, p. 2).

Within this narrative, Strand et al (2016) continue, the metaphor of science as the "endless frontier" is indicative of a belief in economic prosperity that could only be sustained by continued and expanding consumption. Hence the requirement for production and invention of ever new products to create new consumers' needs. In this view, material objects emerge as reifications of knowledge made accessible by the sciences and such processes can only be sustained through large-scale, expanding energy production; nuclear power as a case in contest reflects the aspiration to conquer by progressive internalisation of resources into the techno-scientific economy. A corollary of this position is that a model of governance by numbers, seeking to be informed by the promises of scientific rationality (Nowotny, 2015), fails to recognize the areas of uncertainty, and the opportunities for disclosing alternative imaginaries and visions for sustainability (Avila, 2018).

Going further about participation

In pursuit of an integrative, albeit tentative, position, the theoretical framework of post-normal science offers a set of useful insights for how to cope with the tensions of the governance of science and technology under the challenge of sustainability (Funtowicz and Strand, 2011; Benessia et al., 2012). To participate in decision making processes involves gathering factual and technical information, but also taking into consideration power, customs, time, and codes of participation, which inevitably shape and frame the possibility for people to be 'in the process'. In this view, both the context and design of the research will affect the outcome of decisions, as it has been well documented by teams of researchers who

seek to develop methodologies for participation in trans-disciplinary spaces (de Vente, Reed et al., 2016).

Going further, a second implication derived from the recognition of no demarcation between science and politics would also concern the politics of nature, a construct which has been so variously defined by different disciplines to have become somehow elusive (Lamb, 1996). Here we are confronted with the wicked question of 'what nature is', a concept which seems to have reason to exists only in counter-opposition to humanity (Greaves, 2016). Yet, taking a post-normal science view calls for a transcendence of such dichotomy, as participation as broadly conceived should include both humans and non-humans, living and non-living forms. Transcending boundaries and categories which are culturally and historically encoded in the very fabric of our lives however, is neither an easy or singular step.

Zweers (2000) conceives of the human-nature relationship through a collection of many possible approaches (he refers to six basic attitudes), which describe human positionings in the natural systems. The six attitudes differ for the degree to which they adhere to a 'view of nature' from above or from afar, or a view 'from within', as 'being in the environment', becoming aware that 'we are part of nature', and not 'a part of it' (Gray and Colucci-Gray, forthcoming 2018). This notion recognises the fundamental process of constitutive co-ingredience linking together living organisms with their environment (Maturana and Varela, 1987). In this view, the making of one is coupled with the making of the other in ongoing exchanges of matter, energy, and information. This position of course recognises human self-interests in the same way as the enlightenment position did, with its emphasis on control, rationality and quantification of the environment. The fundamental difference between the two attitudes however is that participation in and with nature entails that humans derive a meaning from their belonging to Nature (Zweers, 2000. P. 50). On such basis, limits to one's demands and awareness of impacts from one's actions emerge s part of one's ability to feel part of and in relation to the environment. Again, differently from a separatist stance, such limits are not to be fought or overcome through conquering, but they recognised as part of one's process of learning to belong, to adjust and co-construct one's place in a shared environment. Notably, such idea of co-existence has both psychological and spiritual connotations as evidenced by growing literature on resilience and well-being deriving from close contact with other living and non-living forms (Restall and Conrad, 2015).

From a philosophical point of view, such considerations recall the Heideggerian idea of being human as 'dwelling', that is, a form of attending to, cultivating and being in the environment. Dwelling is not an inactive or passive state. Rather, it is an existential process of self-realisation in relation with others:

> *"Being-in-the-world means to live among things with which one is ordinarily and proximally familiar, to dwell in places that afford possibilities for being and involvement with others, to see one's self thrown and projected (a potentiality to be), and to stay in a place that one cultivates by making space for things, projects, and beings and safeguarding them or showing care toward them. These are the structural features of being-in-the-world in its average everydayness, that is, the conditions that are necessary for the enjoyment of being in the normal course of things"* (French, 2015, p. 352).

Participation can thus be interpreted 'ecologically' as a process which enable us to participate in the self-ordering of nature, instead of interfering from outside as it is more common with the technologies of control. Yet, as Zweers (2000) remarks, "such mode of participation is not at all self-evident or 'natural' (p. 153), as broadly testified by the current situation marked by global poverty, conflict, exclusion and displacement. The essence of ecological participation may thus rely upon the possibility of a reflexive form of education seeking to destabilise given socio-cultural frames of oppression and segregation through creative processes of cultural formation. In this view, culture only fully comes to being when immersed in nature, the ecosystem and it is from the ecosystem that it carries both aesthetic cues and conceptual frames. Arguably, this process has already begun in many educational contexts seeking to embed ideas of sustainability. We note here Jones' concept of the Biophilic University (Jones, 2013) as a place designed to stimulate 'psychic connectedness to nature'; a sense of well-being and belonging which may go some way towards addressing both needs for acceptance and biological fulfilment. Similarly, Van Boeckel (2017), argues for the role of the University to focus more openly on the practice of active non-activeness, a form of sensorial attentiveness shifting focus from more conventional views of product-based activities and the performances of individuals (e.g. student, teacher, facilitator, instructor), to the qualities of their *patterned relationships* (p. 79). Such examples point to a dynamic perspective which does not call upon dialogue as a means to assign each person their rightful place in the world, or dialogue as conviviality amongst privileged friends, but as an experience of personal maturation and understanding of one's positioning and concern for others, a willingness to be and to partake with others, in the world.

Concluding thoughts

This paper aimed to discuss the many layers of reflection embedded in the quest for a process of knowledge production which can respond to the challenges faced by humanity in the Anthropocene. It is argued that an epistemological shift needs to occur from a view which emphasises linearity and measurement to a view which recognises uncertainty and diversity; such a view entails the ability to think through relationships at a low power as such is the position which enables to opt for solutions which may be reversible, in case initial assumptions turned out to be wrong. Such a shift however is not accidental. Probing the nature and quality of participation is a necessary imperative and a condition to be fulfilled by an educational process which does not rely on vertical transmission of information but offers opportunities for bringing the ecological view into being, at all levels of research, teaching and practice. There is no simple recipe or solution to tackling the 'dilemmas of inclusion', but a variety of possibilities, when seeking to meet the challenges and the opportunities of sustainability.

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